Chapter 6

Nonradiological Effluent Monitoring

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NONRADIOACTIVE air emissions originating at Savannah River Site (SRS) facilities are monitored at their points of discharge by direct measurement, sample extraction and measurement, or process knowledge. Air monitoring is used to determine whether all emissions and ambient concentrations are within applicable regulatory standards.

Nonradiological liquid effluent monitoring encompasses sampling and analysis and is performed by the Environmental Protection Department's Environmental Monitoring Section (EMS), the Site Utilities Department, and the Savannah River Technology Center.

A complete description of EMS sampling and analytical procedures used for nonradiological monitoring can be found in sections 1101–1111 (SRS EM Program) of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1. A summary of data results is presented in this chapter; more complete data can be found in *SRS Environmental Data for 2001* (WSRC–TR–2001–00475).

Airborne Emissions

The South Carolina Department of Health and Environmental Control (SCDHEC) regulates nonradioactive air emissions—both criteria pollutants and toxic air pollutants—from SRS sources. Each source of air emissions is permitted or exempted by SCDHEC, with specific limitations identified. The bases for the limitations are outlined in various South Carolina and federal air pollution control regulations and standards. Many of the applicable standards are source dependent, i.e., applicable to certain types of industry, processes, or equipment. However, some standards govern all sources for criteria and toxic air pollutants and ambient air quality. Air pollution control regulations and standards applicable to SRS sources are discussed briefly in appendix A, "Applicable Guidelines, Standards, and Regulations." The SCDHEC air standards for toxic air pollutants can be found at http://www.scdhec.net/baq on the Internet.

At SRS, there are 172 permitted/exempted nonradiological air emission sources, 133 of which were in operation in some capacity during 2001. The remaining 39 sources either were being maintained in a "cold standby" status or were under construction.

Description of Monitoring Program

Major nonradiological emissions of concern from stacks at SRS facilities include sulfur dioxide, carbon monoxide, oxides of nitrogen, particulate matter smaller than 10 microns, volatile organic compounds (VOCs), and toxic air pollutants. Facilities that have such emissions include diesel engine-powered equipment, package No. 2 fuel oil steam generators, powerhouse coal-fired boilers, the Defense Waste Processing Facility, the in-tank precipitation process, groundwater air strippers, and various other process facilities. Emissions from SRS sources are determined during an annual emissions inventory from calculations using source operating parameters such as fuel oil consumption rates, total hours of operation, and the emission factors provided in the U.S. Environmental Protection Agency (EPA) "Compilation of Air Pollution Emission Factors," AP–42. The calculation for boiler sulfur dioxide emissions also uses the average sulfur content of the coal and assumes 100-percent liberation of sulfur and 100-percent conversion to sulfur dioxide. Most of the processes at SRS are unique sources requiring nonstandard, complex calculations that use process chemical or material throughputs, hours of operation, chemical properties, etc., to determine actual emissions. In addition to the annual emissions inventory, compliance with various standards is determined in several ways, as follows:

At the SRS powerhouses, stack compliance tests are performed every 2 years for each boiler by airborne

emission specialists under contract to SRS. The tests include

- sampling of the boiler exhaust gases to determine particulate emission rates and carbon dioxide and oxygen concentrations
- laboratory analysis of coal for sulfur content, ash content, moisture content, and British Thermal Unit (BTU) output

Sulfur content and BTU output are used to calculate sulfur dioxide emissions. SCDHEC also conducts visible-emissions observations during the tests to verify compliance with opacity standards. The day-to-day control of particulate matter smaller than 10 microns is demonstrated by opacity meters in all SRS powerhouse stacks.

The A-Area powerhouse also has a baghouse dust collection system for the ash handling process. The permit for this system requires monitoring the pressure drop across the baghouse.

For the package steam generating boilers in K-Area and for two portable units, compliance with sulfur dioxide standards is determined by analysis of the fuel oil purchased from the offsite vendor. The percent of sulfur in the fuel oil must be below 0.5 and is reported to SCDHEC each quarter. Compliance with particulate emission standards initially was demonstrated by mass-balance calculations rather than stack emission tests.

Compliance by SRS diesel engines and other process stacks is determined during annual compliance inspections by the local SCDHEC district air manager. The inspections include a review of operating parameters; the operating hours recorded in logbooks; an examination of continuous-emission monitors, where required for process or boiler stacks; and a visible-emissions observation for opacity. In 2000, SCDHEC revised permits for diesel-powered equipment to require the use of annual fuel oil consumption as the basis for determining permit compliance. Fuel oil consumption records are compiled monthly for each permitted diesel unit, and total unit consumption is compared to a total allowable consumption limit. This method of compliance determination was implemented in January 2001.

With the exception of the Consolidated Incineration Facility (CIF), which must be tested once every 3 years for both toxic and criteria air pollutants, there are no specific monitoring requirements for SRS sources of toxic air pollutants. Because some toxic air pollutants also are regulated as VOCs, some SRS sources are required to calculate and report VOC emissions on a quarterly basis.

Table 6–1
SRS Power Plant Boiler Capacities

Location	Number of Boilers	Capacity (BTU/hr)
A-Area	2	71.7E+06
H-Area	3	71.1E+06

Compliance by all toxic air pollutant and criteria pollutant sources also is determined by using EPA-approved air dispersion models. Air dispersion modeling is extremely conservative unless refined models are used. The Industrial Source Complex Version No. 3 model was used to predict maximum ground-level concentrations occurring at or beyond the site boundary for new sources permitted in 2001.

Monitoring Results

As noted earlier, the calculation of emissions each year as part of an annual emissions inventory is the primary means of monitoring SRS air sources. In 2001, operating data were compiled and emissions calculated for 2000 operations for all site air emission sources. Because this process, which begins in January, requires up to 6 months to complete, this report will provide a comprehensive examination of total 2000 emissions, with only limited discussion of available 2001 monitoring results. A review of the calculated emissions for calendar year 2000 determined that SRS sources had operated in compliance with permitted emission rates. Actual 2001 emissions will be compiled and reported in depth in the *SRS Environmental Report for 2002*.

Two power plants with five coal-fired boilers are operated by Westinghouse Savannah River Company (WSRC) at SRS. These boilers are used to generate steam, which is used for facility heating systems and, where required, as process steam. The location, number of boilers, and capacity of each boiler for these plants are listed in table 6–1. The A-Area and H-Area boilers are overfeed stoker fed and use coal as their only fuel. As indicated earlier, the coal-fired boilers are required to be stack tested every 2 years. In order to stagger the test dates for the A-Area boilers, A-Area boiler No. 1 was stack tested in February 2001, approximately 13 months before the test actually was required. Test results, shown in table 6–2, indicated the boiler was being operated in compliance with permitted emission rates. All three H-Area boilers, which are in standby status, will be tested upon being restarted.

The A-Area boiler ash handling system includes a filter baghouse for control of particulate emissions

Table 6–2
Boiler Stack Test Results (A-Area)

Boiler	Pollutant	Emission Rates	
		lb/10^6 BTU	lb/hr
A #1	Particulates[a]	0.43	31.94
	Sulfur dioxide[a]	NC[b]	NC[b]

a The compliance level is 0.6 lb/million BTU for particulates and 3.5 lb/million BTU for sulfur dioxide.
b Not calculated

when removing ash from the boilers. The permit for this system requires maintenance, calibration, and monitoring of the differential pressure across the baghouse to ensure proper operation of the baghouse filters. During the annual compliance inspection in March 2001, SCDHEC determined that the gauge and instrumentation had not been maintained and calibrated as required. This resulted in SRS being issued a notice of violation, but the site still achieved a permit compliance rate of 99 percent for 2001.

SRS also has four package steam generating boilers fired by No. 2 fuel oil. The steam from these boilers is used primarily to heat buildings during cold weather, but also for process steam. The location, number of boilers, and capacity of each boiler are shown in table 6–3. During 2001, only the 76.8- and 38.0-million BTU/hr boilers were operated. The percent of sulfur in the fuel oil burned during the year was certified by the vendor to meet the requirements of the permit. The two 17.0-million BTU/hr boilers had not been operated in several years and therefore were excessed in 2001.

At SRS, 102 permitted and exempted sources, both portable and stationary, are powered by internal combustion diesel engines. These sources include portable air compressors, diesel generators, emergency cooling water pumps, and fire water pumps ranging in size from 150 to 2,050 kilowatts for generators and 200 to 520 horsepower for air compressor and pump engines. During the 2001

Table 6–3
SRS Package Steam Boiler Capacities

Location	Number of Boilers	Capacity (BTU/hr)
K-Area	1	76.8E+06
K-Area	1	38.0E+06
Portable	2	17.0E+06

Table 6–4
2000 Criteria Pollutant Air Emissions

Pollutant Name	Actual Emissions[a] (Tons/Year)
Sulfur dioxide	4.83E+02
Total suspended particulates	3.72E+02
PM_{10} (particulate matter 10 microns)	1.49E+02
Carbon monoxide	2.66E+03
Ozone (volatile organic compounds)	1.44E+02
Gaseous fluorides (as hydrogen fluoride)	1.23E–01
Nitrogen dioxide	3.51E+02
Lead	1.30E–01

a From all SRS sources (permitted and nonpermitted)

compliance inspections, the hours of operation, fuel oil consumption, and opacity for all inspected diesel engines were found to be in compliance. Fuel oil consumption for all diesel engines operated in 2000 was 573,363 gallons. Total fuel consumption for 2001 will be included in the report for calendar year 2002.

Another significant source of criteria pollutant emissions at SRS is the burning of forestry areas across the site. The U.S. Department of Agriculture Forest Service–Savannah River (USFS–SR, formerly the Savannah River Natural Resource Management and Research Institute) periodically conducts controlled burning of vegetation and undergrowth as a means of preventing uncontrolled forest fires. During 2000, USFS–SR personnel burned 10,039 acres across the site.

Other sources of criteria pollutants at SRS are too numerous to discuss here by type. Table 6–4 provides the 2000 atmospheric emissions results for all SRS sources, as determined by the air emissions inventory conducted in 2001. All calculated emissions were within applicable SCDHEC standards and permit limitations during 2000.

Thirty-one of the SRS permitted sources are permitted for toxic air pollutants; 17 of these were operated during 2001. Several of the toxic air pollutant sources—specifically, the soil vapor extraction and air stripper units—have permit conditions requiring the calculation of the running total annual VOC emissions, which are to be calculated quarterly. During 2001, the calculated annual VOC emissions were determined to be well below the permit limit for each unit. As discussed in the description of the monitoring program, the CIF must be stack tested every 3 years. This facility last was tested in April 1997 and was not due for testing again until April 2000. However, all CIF operations

were suspended in 2000, and the facility was placed on cold standby. Stack testing thus was postponed until the resumption of operations.

Total toxic air pollutant emissions at SRS are determined annually in tons per year for each pollutant. It should be noted that some toxic air pollutants (e.g., benzene) regulated by SCDHEC also are, by nature, VOCs. As such, the total for VOCs in table 6–4 includes toxic air pollutant emissions. It also should be noted that table 6–4 includes the emissions for some hazardous air pollutants that are regulated under the Clean Air Act but not by SCDHEC Standard No. 8. These pollutants are included because they are compounds of some Standard No. 8 pollutants.

Ambient Air Quality

Under existing regulations, SRS is not required to conduct onsite monitoring for ambient air quality; however, the site is required to show compliance with various air quality standards. To accomplish this, air dispersion modeling was conducted during 2001 for new emission sources or modified sources as part of the sources' construction permitting process. The modeling analysis showed that SRS air emission sources were in compliance with applicable regulations.

South Carolina and Georgia continue to monitor ambient air quality near SRS as part of the network associated with the Clean Air Act. Resulting data are available to the public through (1) the South Carolina Bureau of Air Quality and (2) the Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch.

Liquid Discharges

Description of Monitoring Program

SRS monitors nonradioactive releases to surface waters through the National Pollutant Discharge Elimination System (NPDES), as mandated by the Clean Water Act. As required by EPA and SCDHEC, SRS has NPDES permits for discharges to the waters of the United States and South Carolina. These permits require that SRS test water discharged from the site for certain pollutants. Also mandated are specific sites to be monitored, parameters to be tested, and monitoring frequency—as well as analytical, reporting, and collection methods. Detailed requirements for each permitted discharge point—including parameters sampled for, permit limits for each parameter, sampling frequency, and method for collecting each sample—can be found in the individual permits, which are available to the public through SCDHEC's Freedom of Information office at (803) 734–5376.

In 2001, SRS discharged water into site streams and the Savannah River under three NPDES permits: one for industrial wastewater (SC0000175) and two for stormwater runoff—SCR00000 (industrial discharge) and SCR10000 (construction discharge). A fourth permit, ND0072125, is a "no discharge" water pollution control land application permit that regulates sludge application and related sampling at onsite sanitary wastewater treatment facilities.

Permit SC0000175 regulated 31 industrial wastewater outfalls in 2001 (figure 6–1). Permit SCR000000 requires a representative sampling of site stormwater discharges; the 2001 stormwater sampling program included 13 outfalls. Permit SCR100000 does not require sampling unless requested by SCDHEC to address specific discharge issues at a given construction site; SCDHEC did not request such sampling in 2001.

NPDES samples are preserved in the field according to 40 CFR 136, the federal document that lists specific sample collection, preservation, and analytical methods acceptable for the type of pollutant to be analyzed. Chain-of-custody procedures are followed after collection and during transport to the analytical laboratory. The samples then are accepted by the laboratory and analyzed according to procedures listed in 40 CFR 136 for the parameters required by the permit.

The effectiveness of the NPDES monitoring program is documented by a surveillance program involving chemical and biological evaluation of the waters to which effluents have been discharged. More monitoring information can be found in chapters 7, "Nonradiological Environmental Surveillance," and 10, "Special Surveys and Projects."

Monitoring Results

SRS reports analytical results to SCDHEC through a monthly discharge monitoring report, which includes an explanation concerning any analytical measurements outside permit limits and a summary of all analyses performed at each permitted outfall.

Twenty-eight of the 31 outfalls permitted by SC0000175 in 2001 discharged. Results from 24 of the 5,386 sample analyses performed during the year exceeded permit limits.

A list of 2001 NPDES exceedances appears in table 6–5. Figure 6–2 shows the NPDES exceedances at SRS from 1992 through 2001, along with the site's compliance rate for each year. SRS achieved a

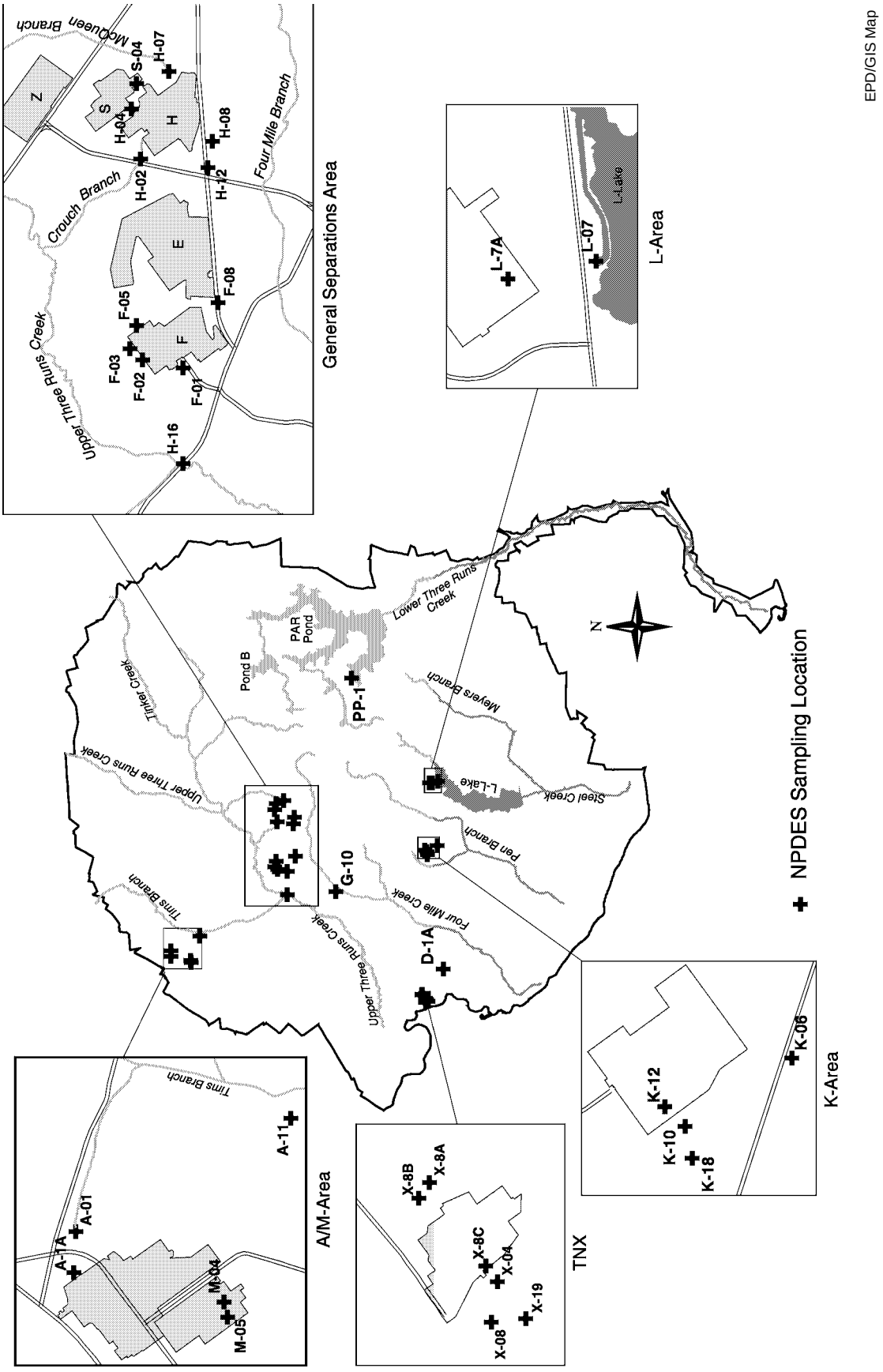


Figure 6–1 NPDES Sampling Locations
Thirty-one industrial wastewater outfalls were regulated at SRS under NPDES Permit SC0000175 during 2001.

99.6-percent compliance rate—higher than the DOE-mandated 98-percent rate.

The 2001 exceedance total of 24 represents an increase from the 18 exceedances of 2000. Chronic-toxicity failures accounted for 17 of the 24 exceedances. The remaining seven were attributable to process upsets, analytical errors, or unknown reasons. Toxicity identification evaluation analyses have been unable to determine the source of the toxicity. It likely is an artifact associated with the low-hardness condition of SRS waters and the condition's effects on the non-native test organism *(Ceriodaphnia dubia*) mandated for use by the NPDES protocol (rather than due to a specific toxicant). The site is exploring this possibility through a series of chronic toxicity tests (i.e., tests of survivorship and reproduction during long-term exposure to SRS waters, as well as to toxicants) using a native test species (*Daphnia ambigua*). Preliminary data suggested that *Daphnia ambigua* may be a more appropriate test organism because of its lack of sensitivity to the low-hardness conditions of SRS waters.

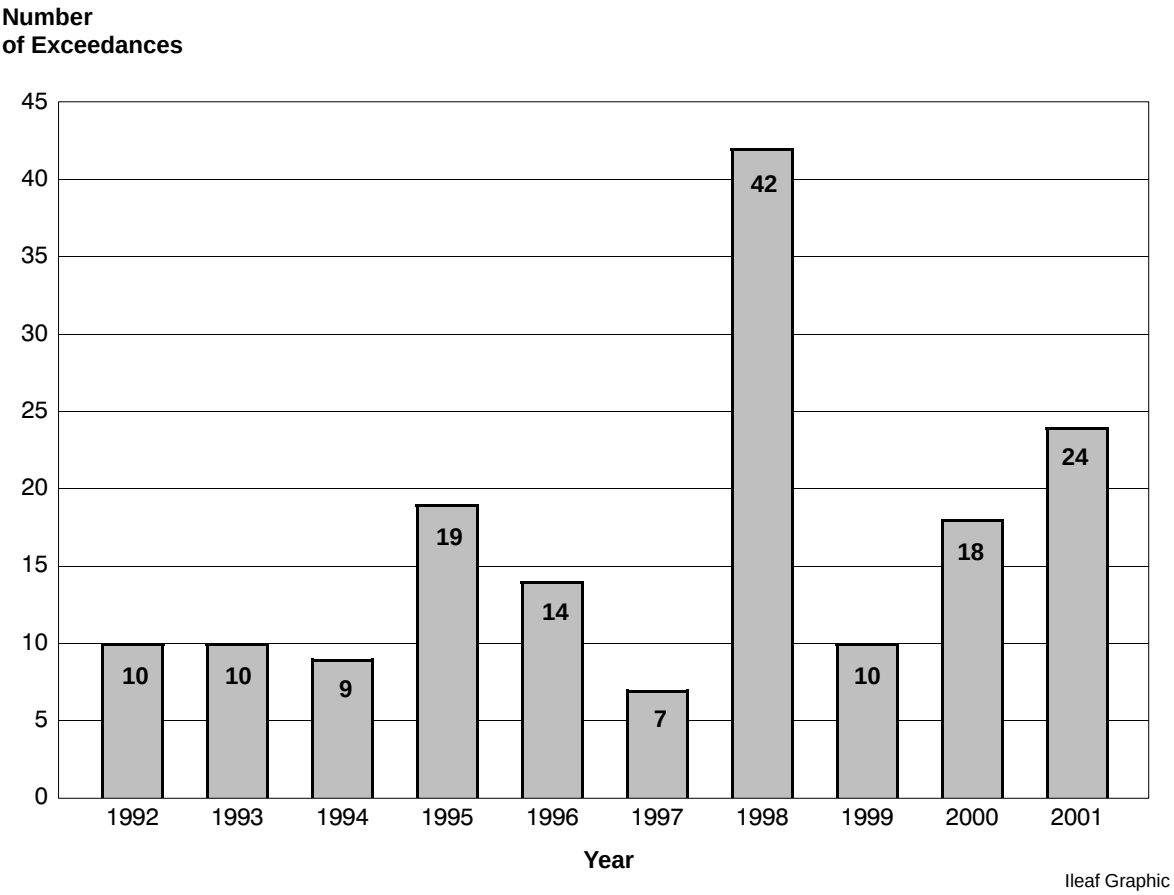
SRS received approval from EPA and SCDHEC in late 2001 to use *Daphnia ambigua* as the species for chronic-toxicity testing. For technical and legal reasons, however, the site appealed this approval, and negotiations began between SRS and SCDHEC to resolve the issues in question. Meanwhile, the site continues to conduct chronic-toxicity testing using *Ceriodaphnia dubia* and *Daphnia ambigua.* Results have shown that the effluent often fails using *Ceriodaphnia dubia* but consistently passes with *Daphnia ambigua.*

During 1996 NPDES permit application testing, it was noted that the A–01 outfall effluent had high concentrations of copper and zinc as well as chronic-toxicity failures. During permit negotiations, SRS agreed to eliminate these problems by October 1, 1999. Due to a misunderstanding between the site and SCDHEC, this deadline was not met, and a consent order subsequently was issued extending the compliance deadline to October 1, 2001. SRS personnel studied the compliance problem and constructed a wetland treatment system (completed in 2001) to remove metals and thus comply with the permit limits. Since startup of this system, the metal concentrations have consistently decreased and have been within permit limits. The chronic-toxicity problems continued with *Ceriodaphnia dubia* through 2001, however.

The early toxicity difficulties were considered hard failures attributable to mortality among the test organisms. The failures during 2001 are believed to be due to slight differences between the reproductive numbers of the control organisms and the test organisms; similar problems were encountered at the A–11 and G–10 outfalls. These more recent failures are believed to have been caused by the softness of the effluent.

A total of 425 analyses were performed during 2001 on stormwater discharge samples. SCDHEC has not mandated permit limits for stormwater outfalls.

During the second quarter of 2001, dewatered sludge was sampled and analyzed for pollutants of concern, and approximately 39 cubic yards of sludge was applied to the land. No sludge was applied during the first, third, and fourth quarters. The analytical results indicated that pollutant concentrations were within regulatory limits.



Year	*Number of Analyses*	*Compliance Rate*
1992	7,729	99.9%
1993	8,000	99.9%
1994	7,568	99.9%
1995	7,515	99.8%
1996	5,737	99.8%
1997	5,758	99.9%
1998	5,790	99.3%
1999	5,778	99.8%
2000	5,496	99.7%
2001	5,386	99.6%

Figure 6–2 History of NPDES Exceedances at SRS, and Site's Compliance Rate, 1992–2001

The chart and table provide historical information about NPDES exceedances from SRS liquid discharges to South Carolina waters, including the number of exceedances—and the site's compliance rate—for each year from 1992 to 2001.To determine the compliance rate, the number of analyses not exceeding limits for a given year is divided by the total number of analyses. For example, 5,386 analyses were performed in 2001, with 24 exceedances. To calculate the compliance rate for that year, divide 5,362 (5,386 minus 24) by 5,386 for a quotient of .9955—or 99.6 percent.

Table 6–5
2001 Exceedances of SCDHEC-Issued NPDES Permit Liquid Discharge Limits at SRS

Department/ Division	Outfall	Date	Parameter Exceeded	Result	Possible Cause	Corrective Action
SUD	K–06	Jan. 24	pH	8.7 SU	High-pH boiler discharge	Coordinate discharge with cooling water
SUD	K–06	Jan. 25	pH	8.8 SU	High-pH boiler discharge	Coordinate discharge with cooling water
FSS/LSD/LOS	A–01	Oct. 8	C–TOX	Fail	Unknown[a]	Under investigation
FSS/LSD/LOS	A–01	Nov. 5	C–TOX	Fail	Unknown[a]	Under investigation
ER	A–11	Jan. 8	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	Feb. 12	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	March 5	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	April 16	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	May 7	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	June 6	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	July 26	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	Aug. 7	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	Sept. 14	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	Oct. 8	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	Nov. 5	C–TOX	Fail	Unknown[a]	Under Investigation
ER	A–11	Dec. 4	C–TOX	Fail	Unknown[a]	Under Investigation
TSD	X–08	Jan. 25	TSS	43 mg/L	X–8B system work led to detritus discharge	Conduct work in no-discharge mode
SUD	G–10	April 30	C–TOX	Fail	Unknown[a]	Under investigation
SUD	G–10	May 20	C–TOX	Fail	Unknown[a]	Under investigation
SUD	G–10	Nov. 26	C–TOX	Fail	Unknown[a]	Under investigation
SUD	G–10	Aug. 11, Aug. 12	Frequency of flow analysis	29 of 31 reported; 31 of 31 required	Lightning disabled flow meters; no flow available	Equipment repaired
SWD	H–16	Sept. 4	Frequency of BOD analysis	3 of 30 reported; 4 of 30 required	Subcontract lab missed hold time	Lab revised procedures/responsibilities

a This outfall failed the C–TOX test, but an investigation into the cause of the failure could not determine a toxicant in the effluent. An alternate species has been proposed, and the outfall has consistently passed the test using the new species.

Table 6–5
2001 Exceedances of SCDHEC-Issued NPDES Permit Liquid Discharge Limits at SRS

Department/ Division	Outfall	Date	Parameter Exceeded	Result	Possible Cause	Corrective Action
NMS&S	F–02	Oct. 22	Permit Part I.A.34	Visible foam	"Simple Green" cleaning agent used to clean CLAB coils; washwater drained to outfall	Cleaning operations stopped; controls evaluated for future operations; sitewide implications addressed

Key: BOD – Biochemical oxygen demand
C-TOX – Chronic toxicity
SU – Standard unit
TSS – Total suspended solids